



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

RE APPLICATION OF: Hui Ou-Yang et al.

SERIAL NO.: Not yet assigned

FILED: February 20, 2002

FOR: HIGH DENSITY PLASMA POST-ETCH
TREATMENT FOR A DIELECTRIC
ETCH PROCESS

§ GROUP ART UNIT: 1746
§ (Parent Application)
§
§ EXAMINER: A. Olsen
§ (Parent Application)
§
§ Attorney Docket No.:
§ AM-3467.C1

Date: February 21, 2002

PRELIMINARY AMENDMENT "A"

**Hon. Commissioner for Patents
Washington, DC 20231**

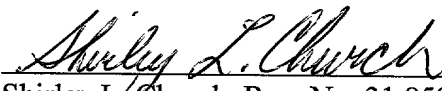
Sir:

This Preliminary Amendment "A" accompanies a continuation application, under 37 CFR § 1.53(b), of U.S. Application Serial No. 09/304,449, filed May 3, 1999.

CERTIFICATE OF MAILING UNDER 37 CFR § 1.10

I hereby certify that this paper is being deposited with the U.S. Postal Service on the date shown below with sufficient postage as U.S. EXPRESS MAIL NO. EU190273688US in an envelope addressed to the: Commissioner for Patents, Box Patent Application, Washington, DC 20231.

Date: February 21, 2002


Shirley L. Church, Reg. No. 31,858

Please amend the application as follows:

IN THE TITLE:

At page 1, line 1, please replace the title with the following title:

-- HIGH DENSITY PLASMA POST-ETCH TREATMENT FOR A DIELECTRIC ETCH
PROCESS --

IN THE CLAIMS:

Please cancel Claims 19 and 20 without prejudice. Please amend the claims as follows.

Claims not being amended are presented in italics for reference purposes.

1. (Once Amended) A method for post-etch treatment of a semiconductor structure following a dielectric etch process, wherein said semiconductor structure includes an overlying dielectric layer into which openings have been etched, wherein the method comprises exposing said semiconductor structure to a high density plasma exhibiting an ionization density of at least 10^{11} e⁻/cm³, generated from a source gas comprising oxygen, a nitrogen-comprising gas, and a reactive gas comprising hydrogen, carbon, and fluorine.
2. *The method of Claim 1, wherein said reactive gas comprises at least one hydrogen-containing fluorocarbon gas.*
3. *The method of Claim 2, wherein said hydrogen-containing fluorocarbon gas is selected from the group consisting of CHF₃, CH₂F₂, CH₃F, C₃H₂F₆, and combinations thereof.*

4. *The method of Claim 1, wherein said reactive gas comprises at least one fluorocarbon gas and hydrogen.*
5. *The method of Claim 4, wherein said fluorocarbon gas is selected from the group consisting of C_2F_6 , C_3F_6 , C_3F_8 , C_4F_6 , C_4F_8 , and combinations thereof.*
6. *The method of Claim 1 or Claim 2 or Claim 4, wherein said nitrogen-comprising gas is N_2 .*
7. *The method of Claim 1, wherein said method further comprises a flushing step performed prior to said post-etch treatment.*
8. *The method of Claim 7, wherein said flushing step comprises exposing said semiconductor structure to a high-flow plasma comprising oxygen.*
9. *The method of Claim 1 or Claim 8, wherein said method further comprises a cleaning step subsequent to said post-etch treatment.*
10. *The method of Claim 9, wherein said cleaning step is performed while said semiconductor structure is present in said process chamber.*
11. (Once Amended) *The method of Claim 9, wherein said cleaning step is performed after said semiconductor structure is removed from said process chamber.*
12. *The method of Claim 1, wherein said post-etch treatment method removes a photoresist layer overlying said dielectric layer.*

13. (Once Amended) A method of post-etch treatment of a semiconductor structure following a dielectric etch process, wherein said semiconductor structure includes an overlying dielectric layer into which openings have been etched, wherein said method comprises the steps of:

a) a flushing step comprising exposing said semiconductor structure to a high-flow plasma comprising oxygen;

b) a post-etch treatment step comprising exposing said semiconductor structure to a high density plasma exhibiting an ionization density of at least 10^{11} e⁻/cm³, generated from a source gas comprising oxygen, a nitrogen-comprising gas, and a reactive gas comprising hydrogen, carbon, and fluorine; and

c) a cleaning step comprising exposing at least a process chamber in which said dielectric etch process was performed to a medium-flow, high density plasma exhibiting an ionization density of at least 10^{11} e⁻/cm³, said plasma comprising oxygen.

14. *The method of Claim 13, wherein said reactive gas comprises at least one hydrogen-containing fluorocarbon gas.*

15. *The method of Claim 14, wherein said hydrogen-containing fluorocarbon gas is selected from the group consisting of CHF₃, CH₂F₂, CH₃F, C₃H₂F₆, and combinations thereof.*

16. *The method of Claim 13, wherein said reactive gas comprises at least one fluorocarbon gas and hydrogen.*

17. *The method of Claim 16, wherein said fluorocarbon gas is selected from the group consisting of C₂F₆, C₃F₈, C₃F₆, C₄F₆, C₄F₈, and combinations thereof.*

18. *The method of Claim 13, wherein said nitrogen-comprising gas is N₂.*

REMARKS

The title has been changed to "HIGH DENSITY PLASMA POST-ETCH TREATMENT FOR A DIELECTRIC ETCH PROCESS" to more accurately reflect the presently claimed invention.

Claims 19 and 20 have been cancelled without prejudice, as set forth above.

Independent Claims 1 and 13 have been amended to recite that the post-etch treatment method of the invention is performed using "a high density plasma exhibiting an ionization density of at least 10^{11} e⁻/cm³". The amendments to Claims 11 and 13 are supported, for example, at page 10, lines 2 - 3 and 12 - 13, and page 11, lines 13 - 21, of applicants' originally filed specification. At page 12, lines 23 - 24, of applicants' specification, the post-etch treatment step is specified to be carried out at a process chamber pressure ranging between about 20 mTorr and 50 mTorr, which allows for the generation and sustenance of a high density plasma within the processing chamber.

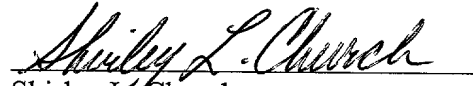
Claim 11 has been amended to depend from Claim 9, to correct an antecedent problem.

The amendments to the claims set forth above are fully supported by the originally filed specification, claims, and drawings, and no new matter has been added to the application as a result of these amendments.

Applicants would like to mention that the amendments to the claims set forth above were made solely for the purpose of expediting allowance of the present application. The amendments should not be construed as agreement with or acquiescence to the Examiner's grounds for rejection of claims in the parent application.

Applicants believe that the presently pending claims as amended are in condition for allowance, and the Examiner is respectfully requested to enter the requested amendments and to pass the application to allowance. The Examiner is invited to contact applicants' attorney with any questions or suggestions, at the telephone number provided below.

Respectfully submitted,


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PRELIMINARY AMENDMENT "A"
VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE TITLE:

At page 1, line 1, the title has been amended as follows:

HIGH DENSITY PLASMA POST-ETCH TREATMENT FOR A DIELECTRIC ETCH
PROCESS

IN THE CLAIMS:

Claims 19 and 20 have been cancelled without prejudice.

Claims 1, 11, and 13 have been amended, as follows.

1. (Once Amended) A method for post-etch treatment of a semiconductor structure following a dielectric etch process, wherein said semiconductor structure includes an overlying dielectric layer into which openings have been etched, wherein the method comprises exposing said semiconductor structure to a high density plasma exhibiting an ionization density of at least 10^{11} e/cm³, generated from a source gas comprising oxygen, a nitrogen-comprising gas, and a reactive gas comprising hydrogen, carbon, and fluorine.

11. (Once Amended) The method of Claim [1,] 9, wherein said cleaning step is performed after said semiconductor structure is removed from said process chamber.

13. (Once Amended) A method of post-etch treatment of a semiconductor structure following a dielectric etch process, wherein said semiconductor structure includes an overlying dielectric layer into which openings have been etched, wherein said method comprises the steps of:

a) a flushing step comprising exposing said semiconductor structure to a high-flow plasma comprising oxygen;

b) a post-etch treatment step comprising exposing said semiconductor structure to a high density plasma exhibiting an ionization density of at least 10^{11} e/cm³, generated from a source gas comprising oxygen, a nitrogen-comprising gas, and a reactive gas comprising hydrogen, carbon, and fluorine; and

c) a cleaning step comprising exposing at least a process chamber in which said dielectric etch process was performed to a medium-flow high density plasma exhibiting an ionization density of at least 10^{11} e/cm³, said plasma comprising oxygen.